Tackling food and electronic waste, NTU scientists use fruit peel to turn old batteries into new ones

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An estimated 50 million tonnes of electronic waste is generated globally each year. — Reuters pic

SINGAPORE, Aug 26 — Scientists led by Nanyang Technological University (NTU) have developed a novel method of using fruit peel to turn old batteries into new ones, the university said in a statement today.

Through the method, fruit peel waste is used to extract and reuse precious metals from spent lithium-ion batteries in order to create new batteries.

The team has, for example, used orange peel to recover precious metals from battery waste efficiently, and then made functional batteries from these recovered metals, creating minimal waste in the process.

Terming it a “waste-to-resource approach”, the scientists say that this method tackles both food waste and electronic waste.

An estimated 1.3 billion tonnes of food waste and 50 million tonnes of e-waste are generated globally each year, the university said.

Spent batteries are conventionally treated with extreme heat (over 500°C) to smelt valuable metals, which emit hazardous toxic gases.

Researchers around the world are exploring alternative approaches, such as using strong acid solutions or weaker acid solutions with hydrogen peroxide to extract the metals, but these still produce secondary pollutants that pose health and safety risks, or rely on hydrogen peroxide which is hazardous and unstable, the scientists noted.

Another alternative being explored is hydrometallurgy, which is the process of using water as a solvent for extraction.

This process involves first shredding and crushing used batteries to form a crushed material called black mass. Researchers then extract valuable metals from black mass by dissolving it in a mix of strong acids or weak acids plus other chemicals like hydrogen peroxide under heat, before letting the metals precipitate.

The NTU team found that the combination of orange peel that has been oven-dried and ground into powder and citric acid, a weak organic acid found in citrus fruits, can achieve the same goal.

Through lab experiments, the team found that their approach successfully extracted around 90 per cent of cobalt, lithium, nickel and manganese from spent lithium-ion batteries, which they said is a comparable efficacy to the approach using hydrogen peroxide.

Assistant Professor Dalton Tay of the NTU School of Materials Science and Engineering and School of Biological Sciences said: “The key lies in the cellulose found in orange peel, which is converted into sugars under heat during the extraction process. These sugars enhance the recovery of metals from battery waste.

“Naturally occurring antioxidants found in orange peel, such as flavonoids and phenolic acids, could have contributed to this enhancement as well.”

Solid residues generated from this process were also found to be non-toxic, suggesting that this method is environmentally sound, added Professor Tay.

New lithium-ion batteries assembled from the recovered materials showed a similar charge capacity to commercial ones.

The university said that further research is underway to optimise the charge-discharge cycling performance of these new batteries made from recovered materials. — TODAY